DOCUMENT RESUME

ED 046 989 TM 000 351

AUTHOR	Goolsby, Thomas M., Jr.
TITLE	Evaluation of Cognitive Development: An Observational Technique--Pre-Mathematics Skills Inventory.
INSTITUTION	Georgia Univ., Athens. Research and Development Center in Educational Stimulation.
SPONS AGENCY	Research and Development Centers Branch, DEL.
REPORT NO	RP-11
BUREAU NO	BR-5-0250-014
PUB DATE	Jun 69
CONTRACT	OEC-6-10-061
NOTE	33p.
AVAILABLE FROM	Thomas M. Goolsby, Jr., Dept. of Ed. Psychology, Measurement, and Research, University of Georgia, Athens, Georgia 30601
EDRS PRICE	EDRS Price MF-$0.65 HC Not Available from EDRS.
DESCRIPTORS	Check Lists, *Classroom Observation Techniques, *Cognitive Development, Cognitive Processes, *Early Childhood Education, Early Experience, Kindergarten Children, *Learning Readiness, *Mathematical Concepts, Preschool Children, Preschool Learning, Student Evaluation

ABSTRACT

The development of an instrument for evaluating cognitive growth in preprimary children by means of observational techniques is reported. Areas of growth in pre-mathematic skills were defined for this purpose as: Imitating, recognizing, classifying, matching, comparing, understanding, counting, computing, and measuring. Each is described, and illustrated. Symptoms of gowth in each of the areas are listed and guides for determining this growth in a child are provided. The inventory can be used as a class record or as an individual profile for the recording of positive observations of symptoms of pre-mathematics skills. Teachers note, record, and date observations of preprimary children as they show developmental progress. The inventory can be used as an aid in observing beginning first graders, prekindergarten, or kindergarten children for mathematics readiness. (TA)

EDO 46989

PERMISSION TO REPRODUCE THIS COPY RIGHTED MATERIAL BY MICROFICHE ONLY HAS BEEN GRANTED BY

Thomas Goolsby

TO ERIC AND ORGANIZATIONS OPERATING UNDER AGREEMENTS WITH THE U.S. OFFICE OF EDUCATION FURTHER REPRODUCTION OUTSIDE THE ERIC SYSTEM REQUIRES PERMISSION OF THE COPYRIGHT OWNER"

Research Paper No. 11

EVALUATION OF COGNITIVE DEVELOPMENT

An Observational Technique

Pre-Mathematics Skills

Thomas M. Goolsby, Jr.

June, 1969

TM 000 351

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEH REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

Research and Development Center in Educational Stimulation

University of Georgia Athens, Georgia

ED046989

Research Paper No. 11

EVALUATION OF COGNITIVE DEVELOPMENT

An Observational Technique in Pre-Mathematics Skills

Thomas M. Goolsby, Jr.
Associate Director for Evaluation
Research and Development Center in Educational Stimulation

Prepared for the Evaluation Division of the
Research and Development Center in Educational Stimulation
University of Georgia
Athens, Georgia
June, 1969

The curriculum development reported in this publication was performed as part of the activities of the Research and Development Center in Educational Stimulation, University of Georgia, pursuant to a contract with the United States Department of Health, Education and Welfare, Office of Education, under Provisions of the Cooperative Research Program.

Center No. 5-0250 Contract No. OE 6-10-061

Copyright applied for

FOREWORD

The Project Staff believes that this is a fair, valid method for evaluating the growth of preprimary children by means of an Observational Technique.

It is thought that the Manual provides explanations and guides which will enable one to use the Inventory to show the development of each child individually, and in relation to his class, from the time he enters preprimary until he enters first grade. Thus, a measure of his readiness will be apparent when he begins primary school.

The content of this project has been largely determined by preprimary teachers whose experiences, observations, and practices afford some background for it.

It is hoped that it will be found to be stimulating to use and effective in results.

Teachers and supervisors are requested to report their comments and reactions to the content of the instrument, as well as any difficulty experienced in learning to use it and in using it. Since this is an experimental edition, it is important to obtain data to make estimates of reliability, validity and other measurement characteristics of a technical nature.

The Project Staff

ACKNOWLEDGMENTS

Board of Education, Clayton County, Georgia
Dr. Lacy Powell, Director of Research, Clayton County
Mr. Douglas Barton, Principal, Suder School, Clayton County
Mr. Irvin Cole, University of Georgia, R and D Representative

Project Staff

Director

Thomas M. Goolsby, Jr.

Consultants

Warren G. Findley
Research and Development Center

John Dobbin
Educational Testing Service

Research Assistants

Barbara Darby

Grace A. Wray

Preprimary Teachers

Elaine Estabrook
Phyllis Holbrooks
Mimi Holland

Elizabeth McCarton
Shirley Ray
Marian Sorrow

TABLE OF CONTENTS

	Page
Foreword	ii
Acknowledgments	iii
Table of Contents	iv
Introduction	1
Rationale for the Project	2
Purposes of the Project	3
Procedure	4
Areas of Growth	5
Directions For Using the Inventory	6
Inventory	8
Descriptions and Guides for Use With Inventory	
Imitating	10
Recognizing	12
Classifying	14
Matching	16
Comparing	18
Understanding	20
Counting	22
Computing	24
Measuring	26
References	28

INTRODUCTION

This effort to devise a method of evaluating the learning development of preprimary children was the outgrowth of a study in Early Childhood Education conducted by the Research and Development Center in Educational Stimulation at The University of Georgia.

The study has been in existence since fall of 1966 when children three, four, and five years of age were enrolled in a preprimary educational program at Suder School in Clayton County, Georgia. Since that time a new group of three-year-olds has been added annually.

Approximately sixty children in each age group have been involved in the preprimary program each year. They have been chosen as representative of a cross section of the local community.

Curriculum and tests have been developed in the various areas of learning in an effort to stimulate the educational development of these children and to evaluate their growth.

RATIONALE FOR THE PROJECT

After using numerous tests of ability and achievement with children of all ages, it became clear that these are not the only types of measures that should be used in evaluating child development.

In dealing with three-, four-, and five-year-olds it seems mandatory that other methods of estimation be used, not only because extensive adequate tests are not available, but because this is a logical area in which to initiate a new type of measure.

This thinking led to an effort to establish "observation" as a technique for evaluating children's learning progress in the pre-primary program at Suder School, an experimental field for the Research and Development Center of the University of Georgia.

Teachers of ten preprimary groups of children, three, four and five years of age, noted the kinds of symptoms that they had observed in the classroom and that they felt showed developmental progress in children's learning.

After these were categorized and arranged in sequential order, the teachers attempted to indicate the observed symptoms as they occurred in each child. As these symptoms became evident and were noted, a profile of the individual child's development was revealed.

Obviously this method of measurement tended toward a better and fuller understanding of the child and his own cognitive development, as well as revealed how children learn and grow.

A special feature of this approach is emphasis on the positive identification of evidence of progress to the exclusion of negative reports. Teachers report only what a child <u>can</u> do.

PURPOSES OF THE PROJECT

Many studies have been made and much has been written about the notion that a large portion of a child's later intellectual development is directly related to his preschool experiences and instruction. For some children, experience and instruction are limited during this important period, and for others these facets are unguided and unstimulated.

It seems pertinent, then, to provide opportunities for children to develop their capacities as far as possible in these early fertile years. Whether they actually develop cognitive skills, or only learn to relate to a stimulating environment with an effective atmosphere for personal development, children need these early childhood experiences on which to build later achievement.

During this period of life, one observes changes in the child's growth. His teacher notes these changes because she looks for them, and also because a school atmosphere is conducive to growth. These changes help a teacher to locate each child on a scale of development and to provide situations that will help him progress along the way. This observational technique for assessing a child's development was developed by noting his behavioral symptoms. These symptoms, not specifically related to the cognitive skills, are important because they form the necessary foundation for later mastery of these skills.

Various symptoms of the sequential development of a child can be noted so as to form a growth scale. Children generally proceed through the same stages though not all give evidence of various symptoms at the same time and they do not necessarily reveal them in the same order.

PROCEDURE

The project aimed at the following goals:

To designate areas of developmental growth in three-, four-, and five-year-olds.

To point out symptoms of growth within these areas.

To describe various activities that enhance this development.

To devise an inventory for recording evidence of these symptoms.

Certain areas of growth were designated in three-, four-, and five-year-old children, and a list of sequential signs of growth in each of these areas in the form of descriptive behaviors was devised. The indicated areas of growth considered were pre-reading skills and pre-mathematics concepts and skills. Only pre-mathematics skills are covered here. Other areas of growth could, of course, be added.

To develop a scale it was necessary for many teachers to have observed many children through the preprimary years in a school situation which provided opportunities, experiences, and guidance for growth. The content of the scale was rethought, rewritten, discussed, and rearranged many times as the teachers observed and followed the changes in the children.

An inventory on which to indicate changes was drawn up and periodic checks were made in order to learn whether a positive sign of certain symptoms could be observed. No record was made of a behavior until it had been observed positively.

AREAS OF GROWTH

Pre-mathematics skills do not presume any training or experience in a mathematics curriculum, but rather evolve as an intellectual growth of the young child through interaction with people and the environment, whereby he gradually develops knowledge, concepts, and skills that help him solve simple everyday problems. The development of these basic ideas can be observed as behavioral symptoms of his growing intellect, and these can be categorized into several areas of pre-mathematics skills.

Some fields of evidences of growth in pre-mathematics skills are: imitating, recognizing, classifying, matching, comparing, understanding, counting, computing, and measuring.

Symptoms to be observed positively are for example: "Counts by rote," "Recognizes shapes," "Classifies according to ordinal position," "Compares sizes," etc. These are only a few of the symptoms for the various categories of signs of growth. A complete list of these symptoms in the form of an Inventory follows.

The categories in the Inventory are not intended to be sequential. Also, they may be construed to overlap somewhat but each seems to have its own unique quality which distinguishes it from the others.

A description of the symptoms together with guides for discerning them follow the sample Inventory.

DIRECTIONS FOR USING THE INVENTORY

The Inventory can be used as:

1. A Class Record
2. An Individual Profile

In using the Inventory as a Class Record, the names of all pupils should be entered at the top of the form between the vertical lines. The date when each child evidenced each symptom positively for the first time should be recorded in the corresponding box in the body of the form. This makes it possible to survey at one time the progress of an entire class to date.

In using the Inventory as an Individual Profile, one child's name should be entered at the top of one form. Dates for noting when symptoms were observed positively for this child should be indicated in sequence above the horizontal lines across the top of the form. A check (✓) should be made in the appropriate box in the body of the form for each accomplishment.

The Class Record is best maintained by noting behavior as it occurs. The Individual Profile can be filled in at frequent intervals or at the end of the period covered by the Class Record. This personal record of a child's progress can be included in his personal folder to be filed in the school office or passed on to the next grade.

The Guides which accompany the description of the categories in the Manual are intended to illustrate a possible method of checking a child's performance on a symptom in case it has not been observed naturally in the regular classroom situation. The Guides are not intended to be used as test items to be applied to all children at a certain time in order to be able to check a symptom on the Inventory. This method would create a too-structured situation which would be similar to the customary testing from which the Observational Technique is planned to depart. Rather, symptoms should be observed over the child's entire preprimary period and checked when a positive performance is observed, and not at some special time.

The period of observation of a class should extend over a semester, a year, or several years of the preprimary period. At anytime, it should be possible to pick up the Inventory and read the progress any child has been observed to have made to date.

Since the Guides are only suggestions for obtaining a response from a child who has not shown a symptom positively, whatever materials are at hand and appropriate to the task may be used instead of those stated.

If the Guides must be used in order to check a performance of a child who has not given evidence of success on a certain symptom, several tasks of the nature being considered should be used and responded to positively, before assuming the behavior accomplished.

This Inventory could also be used as a valuable aid in the beginning first grade in order to observe the pupils' readiness for curriculum. This could be especially helpful with children who have not had preprimary experience, and with slow and disadvantaged groups.

INVENTORY

SYMPTOMS OF COGNITIVE DEVELOPMENT

Pre-Mathematics Skills

Symptoms

Imitating

A. Counts by rote
B. Sings number nursery rhymes
C. Copies patterns
   1. Beads
   2. Blocks
   3. Numerals

Recognizing

A. Colors
   1. Red
   2. Blue
   3. Yellow
   4. Green
   5. Orange
   6. Purple
   7. Brown
   8. Black
B. Shapes
   1. Plane
      a. Line
      b. Circle
      c. Rectangle
      d. Square
      e. Triangle
   2. Solid
      a. Cone
      b. Sphere
      c. Cube
      d. Cylinder
C. Size
   1. Big-Little (Large-Small)
   2. Thick-Thin
   3. Long-Short
   4. Wide-Narrow
   5. High-Low
   6. Tall-Short
D. Numerals
   1. Knows numeral from any other forms
   2. Reads numerals
   3. Writes numerals

Classifying

A. Classifies according to specific properties
B. Classifies as to ordinal position
   1. First to tenth
   2. Last
   3. Middle

TM 000 402

Matching
A. Equivalent relationship--as many as
B. Non-equivalent relationship
   1. More than
   2. Fewer than (Less than)

Comparing
A. Sizes
   1. Bigger-Littler (Larger-Smaller)
   2. Thicker-Thinner
   3. Longer-Shorter
   4. Wider-Narrower
   5. Higher-Lower
   6. Taller-Shorter
B. Quantities
   1. Equal
   2. More
   3. Less

Understanding
A. Whole number concepts
B. Whole-part or fraction concepts
   1. Whole
   2. Half
   3. Quarter

Counting
A. Associates number word with number of elements in a set
B. Knows number in order of size

Computing
Solves appropriate number problems

Measuring
A. Time (Clock)
B. Date (Calendar)
C. Money
   1. Recognition
      a. Penny
      b. Nickle
      c. Dime
      d. Quarter
      e. Dollar
   2. Value (Relative)
D. Weight (Relative)
E. Linear
F. Temperature
G. Age

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
IMITATING

Imitating means following an example or model, or copying. It is a very elementary and natural mode of learning. A child says and does what others say and do. This is one reason it is important for children, very early, to be provided with an environment that lends itself to desirable learning experiences.

Some kinds of imitating indicate the development of pre-mathematics skills. A young child counts by rote when he mimics another child saying 1, 2, 3, 4, 5, etc. This he does mechanically without comprehension, at first, although he says that he is counting. He sings songs and plays games involving numbers long before he can associate the numbers with their concepts. He is imitating what he sees others do and this is one of his earliest experiences with the idea of numbers.

Copying designs with blocks and beads and copying numerals that have been designed as patterns are other activities that are preliminary to his knowledge of numbers. Copying numerals will help to aquaint the child with numerals in written form and to associate the proper number-word with each numeral.

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
IMITATING

Symptoms	Guides
A. Counts by rote	Say: "Can you count?" The child must say the number words in sequence--at least 1, 2, 3. He must start with 1.
B. Sings number nursery rhymes	"One little, two little, three little Indians." "Four little birdies sitting on a tree. One flew away and then there were three."
C. Copies patterns	
1. Beads	Say: (Presenting teacher-made bead stringing design) "Make one just like this one."
2. Blocks	Say: (Presenting teacher-made block arrangement pattern) "Make one just like this one."
3. Numerals	Say: (Presenting pictures of numerals 1 - 10) "Make as many as you can like these." Record number child can do.

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
RECOGNIZING

Recognizing means perceiving as being something known or experienced. Normally, as a child grows, he learns, because he has experiences with more and more things. As he interacts with others and with his environment, he stores images in his brain, and recalls them when similar situations present themselves.

Thus a young child, because of his experiences, learns to recognize certain things which later appear in various fields of learning. Some of these that pertain to mathematics are recognition of various shapes, colors, sizes, and numerals.

Color knowledge, while really not a mathematical learning, is considered here as a pre-mathematics symptom because it is thought to be necessary that a child can learn to distinguish quantities, sets and other mathematics concepts.

Recognition of numerals in the written form and in the spoken form are thought of here as pre-mathematics skills which precede the acquisition of the total concept of numbers.

When a child initially shows an acquaintance with tools that he is expected to later employ in a structured learning situation, he is said to have reached what might be referred to as a "threshold of readiness" for that particular skill.

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
RECOGNIZING

Symptoms	Guides
A. Colors 1. Red 2. Blue 3. Yellow 4. Green 5. Orange 6. Purple 7. Brown 8. Black	Say: "Point to the red one." Continue this procedure with all colors.
B. Shapes 1. Plane a. Line b. Circle c. Rectangle d. Square e. Triangle 2. Solid a. Cone b. Sphere c. Cube d. Cylinder	Say: (Presenting figures on paper, chalk board or flannel board) "Point to the line." Continue this procedure with other shapes.
C. Size 1. Big-Little (Large-Small) 2. Thick-Thin 3. Long-Short 4. Wide-Narrow 5. High-Low 6. Tall-Short	Say: (Presenting two objects one of each size) "Point to the big (little) one." Continue this procedure with the other sizes.
D. Numerals	
1. Knows numeral from any other forms	Say: (Presenting a group of forms as: △ \ L 7 /) "Point to the numeral." Child need not know name of numeral.
2. Reads numerals	Say: (Presenting numerals in random order) "What is this numeral?" Child must say correct number-word for three or more of them as "two" for 2, "five" for 5, etc.
3. Writes numerals	Say: (Presenting numerals in random order) "Write the numeral 2," etc. Record the number of numerals he can do.

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
CLASSIFYING

Classifying means assigning to a category or arranging in classes. It involves the consideration of a particular characteristic in placing an item in a certain group or class.

Specific properties form a basis for classifying. Such qualities as color, size, shape, etc., can be used as factors to be measures of a child's ability to group items into certain classes as a pre-mathematics skill. Classifying presupposes knowledge of the property to be classified.

It may be desired to classify a group of objects in other ways, not only as to their identical perceptual attributes--color, size, or other physical properties--but also as to their functions or other such qualities. In mathematics, classification as to ordinal position is important. A child experiences ordinal position very early, and it is of practical importance throughout his life.

After the skill in one-dimensional classifying has been mastered, classification according to two-dimensional (or more) qualifications is in order, thus getting into subclasses. This is a step, not only in mathematical development, but also in logical thinking in general.

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
CLASSIFYING

Symptoms	Guides
A. Classifies according to specific properties	Say: (Presenting a set of blocks of various colors) "Pick out all the blue (or other color) blocks." Say: (Presenting a group of long and short pencils) "Pick out all the long (short) pencils." Say: (Presenting a group of forms of various shapes) "Pick out all the triangles (or other shapes)." Say: (Presenting a group of animals, people, clothes or other objects) "Pick out all the _____." Teacher may use other examples of this type. Child must score plus on at least three tasks. (Requires only one check on Inventory.)
B. Classifies according to ordinal position	
1. First to tenth	Say: (When children are in line) "First person touch his head." "Sixth person raise his hand." (Teacher may use other examples of this type.) Write in space provided exact number child can do.
2. Last	Say: "Point to the last letter in your name." (Other objects in sequence may be used.)
3. Middle	Say: (Presenting three objects) "Point to the middle one."

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
MATCHING

Matching here means matching for equivalence or nonequivalence in a one-to-one relationship. It involves pairing the members of one group with the members of another group to determine whether there are as many, more, or fewer members in one group when compared to another. Concrete objects or flannel board materials can be used.

This is one method of using sets. It is desirable for a child to comprehend the term sets and to be able to use it appropriately. A set means any collection or group of things or ideas which is described precisely enough to tell whether any given object belongs to it. A child matches objects, which have the same factor in common, into a set such as a set of dishes, set of blocks, and so forth.

The knowledge of sets is helpful in matching for equivalence or nonequivalence. By matching items on a one-to-one relationship, a child determines whether one set is just like (equivalent to) another, or whether it contains more or fewer items than another.

This is a step beyond making just visual comparisons to establish these facts. Matching is basic to the development of the concept of equivalence or nonequivalence.

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
MATCHING

Symptoms	Guides
A. Equivalent relationship-- as many as	Say: (Presenting two equal sets of beads) "Do I have as many red beads as blue beads?"
B. Nonequivalent relationship	Say: (Presenting two unequal sets of blocks) "Which set has more blocks?"
1. More than	
2. Fewer than (less than)	Say: "Which set has fewer blocks?"

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
COMPARING

Comparing involves examining to discover degrees of sameness or difference. As a pre-mathematics skill, the interest lies in comparison of quantities and of sizes.

Size pertains to people or objects. A child very early becomes aware of size in certain personal relationships and associations. As his experiences and social relationships become broader, this concept develops and he sees people and things comparatively or relatively as to size, height, weight, etc.

The symptoms concerning sizes included in this category are the same as those included in the category, "Recognizing." This is because these are the most common sizes with which the young child becomes acquainted very early in his life. While in the category "Recognizing" the child needs only to recognize the symptom, in this category the child needs to be able to view one item in relation to another. For example, he not only recognizes an object as being big or little but he compares it with another to see whether it is bigger or littler.

Comparing quantities at this stage depends largely on visual assessment for the child who has not learned to count or measure. Therefore, quantities to be compared must be obviously the same, more, or less, and containers must be identical.

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
COMPARING

Symptoms	Guides
A. Sizes	
1. Bigger-Littler (Larger-Smaller)	Say: (Indicating two people) "Which one is bigger (littler)?" Continue this procedure with other comparisons.
2. Thicker-Thinner	
3. Longer-Shorter	
4. Wider-Narrower	
5. Higher-Lower	
6. Taller-Shorter	
B. Quantities	
1. Equal	Say: (Using identical containers, present three quantities of sand two of which are equal) "Which two are equal?"
2. More	Say: (Using identical containers present two unequal quantities of paint) "Which one has more paint?"
3. Less	Say: (Using identical containers with unequal amounts of water) "Which one has less water?"

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
UNDERSTANDING

Understanding here means achieving a grasp of the nature, significance, or meaning of certain mathematics concepts although these concepts are not now being applied in a mathematics descipline.

The concepts involved in all the categories need to be understood, of course, but there are many more concepts that children learn from everyday contact with peers and environment, that are helpful later in structured mathematics learning.

Some of these are whole number concepts, and whole-part or fraction concepts. It is important to understand the concept that a number represents. In the preprimary area some children learn to understand the concept of each number from one to ten. Others learn some of these number concepts. Whole-part or fraction concepts develop with everyday experiences as the whole object is observed in relation to its parts, especially a half and a quarter. Other fractional concepts develop as the child matures and becomes involved in the study of mathematics.

PRE-MATHEMATICS SKILLS
FIELD LEARNING
UNDERSTANDING

Symptoms	Guides
A. Whole number concepts	Say: (Presenting a picture with a number of objects (up to 10)) "How many _____ are there in this picture?" Record highest number child knows.
B. Whole-part or fraction concepts	Say: (Presenting apple in whole, half, quarter form) "Give me one-half (whole, quarter) apple."
1. Whole	
2. Half	
3. Quarter	

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
COUNTING

Counting here is thought of as opposed to rote counting. Now we are considering that a child comprehends when he says 1, 2, 3, 4, 5, etc., and that he is not just repeating what he has heard others say. He associates the number word with the number of elements in a set. He knows that when he says "two" he means two things. He has a mental concept of the meaning of the number he verbalizes. In this period of preschool experience, it is likely that he can count intelligently from one to ten.

In counting, the child learns the ordinal position of each number and hence its value in a series of values. He observes each number in the order of size. He associates his position in a line or sequence in relation to others, and he associates the place of an object in ordinal position because he has learned to count.

While counting is really an act of rote memory in the beginning, it becomes functional as it is used comprehensively.

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
COUNTING

Symptoms	Guides
A. Associates number word with number of elements in a set	Say: (Presenting group of cars) "Give me ____ cars." Conceptualizes the number he says as 5, 3, etc.
B. Knows number in order of size	Say: "What number comes after 2?" Say: "What number comes before 5?" Other number orders may be used. Child must score plus on at least three tasks of this type.

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
COMPUTING

Computing in this instance means calculating or reckoning by simple processes or rough-and-ready methods, arrived at by observation and experience rather than by specific training in mathematics. It means the ability to use numbers in nontechnical although quite useful ways.

A child has various exeriences in everyday living that teach him to compute. If he needs five cents for an article he figures how many more pennies he must have than he has. If he needs a dime, he sees he has to have one more nickle than the one he has.

He observes how many more of something his neighbor has than he has, and he thinks out how much candy he will have left if he shares his pieces with a friend.

He learns he can pick up two things at a time to count out ten. He sees how many more napkins he needs to give each child at the table one.

These and many more number situations occur in preprimary experiences and everyday living, and the child learns by figuring them out naturally without mathematical training. Because of these experiences, he is readied for structured learning.

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
COMPUTING

Symptoms	Guides
Solves appropriate number problems	Say: "How many more cookies does Johnny have than you have?" Say: "How many more napkins do we need?" Say: "How many more pennies (nickles) do you need to buy a candy bar?" Say: "If you have one piece of candy and someone gives you one piece, how many will you now have?" Say: "How many times do you have to pick up two blocks to get ten blocks?" Child must score plus on at least three tasks. (Requires only one check on Inventory)

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
MEASURING

Measuring is a broad area in mathematics. Many facets of measuring appear in the experiences of a preschool child. Whatever information about measuring he absorbs during these early years will prepare him to enter more knowledgeably the field of structured mathematics.

His experiences may lead him into some acquaintance with such measuring tools as a clock, a calendar, money, scales, ruler or yardstick, thermometer, and others. How much he learns by his contacts with the various measuring devices will depend upon the extent of his experiences with them, his interest, and his ability to learn. In some cases he may know only vaguely for what purpose the instrument is used while for others he may be able to use or illustrate the use.

These are just a few phases of measurement that a young child is likely to encounter. There are probably many others that some children experience in the preschool years that will help lay the foundation for later learning.

PRE-MATHEMATICS SKILLS
FIELD OF LEARNING
MEASURING

Symptoms	Guides
A. Time (Clock)	Say: (Presenting clock with hands set at any hour) "What time does the clock say?"
B. Date (Calendar)	Say: (Presenting several measuring devices including a calendar) "Which one shows your birthday?"
C. Money	
1. Recognition a. Penny b. Nickle c. Dime d. Quarter e. Dollar	Say: (Presenting money) "Give me a dime (penny, nickle, quarter, dollar)." Child may say five cents for nickle and ten cents for dime.
2. Value (Relative)	Say: (Presenting nickle, dime, penny) "Which one will buy the most?"
D. Weight (Relative)	Say: (Handing child two objects of obviously contrasting weight) "Which one weighs more?"
E. Linear	Say: (Presenting ruler or yardstick) "What is this used for?" (Accept any reasonable response)
F. Temperature	Say: (Showing thermometer) "Point to the direction the red line will go when it gets hotter."
G. Age	Say: "Who is older you or your teacher?" Say: (Pointing to a picture of a group of children including a baby) "Which one is the youngest?"

REFERENCES

Frost, Joe L., Editor. Early Childhood Education Rediscovered. New York: Holt Rinehart and Winston, Inc., 1968.

Goolsby, Thomas M., Jr. Evaluation of Cognitive Development: An Observational Technique Pre-Reading Skills. Athens, Georgia: Research and Development Center in Educational Stimulation, University of Georgia, 1969.

Greater Cleveland Mathematics Program. Educational Research Council of Greater Cleveland, Science Research Associates, Inc., 1962.

Hess, Robert D. and Bear, Roberta Meyer. Early Education. Chicago: Aldine Publishing Co., 1968.

Lets's Look at First Grades. Princeton, New Jersey: Educational Testing Service, 1965.

Mathematics Continuum. Pittsburgh, Pennsylvania: Learning Research and Development Center, University of Pittsburgh, 1968.

Willis, Clarice D. and Lindberg, Lucile. Kindergarten for Today's Children. Chicago: Follett Publishing Co., 1967, pp. 323-387.

Wilson, John A. R., Robeck, Mildred C. Kindergarten Evaluation of Learning Potential. New York: McGraw-Hill Book Co., 1965, pp. 61-72.